Example1:

Your company has been given a 200.10.57.0 network address. You need to divide your network into two subnets (X and Y) using a router, Answer the following questions.

1- **What is the network class?**
2- **How many bits needed to be borrowed form the host field to the subnet field.**
3- **What is the actual number of hosts per subnet**
4- **What is the usable number of hosts per subnet**
5- **What is the subnet mask?**
6- **What is the IP addresses of the routers NICs at both subnets. Assuming that routers NICs at subnets X and Y takes the first usable host IP addresses at the first and second usable subnets respectively.**
7- **Explain the ANDing process when a computer named X1 takes the second usable host IP address at subnet X sends a packet to a second computer named Y1 and takes the second usable host IP address at subnet Y.**
8- **What is the percentage of IP addresses lost due to subnetting**

Answers:-

1- **Since the first octet in the network address is 200, then the IP address is class C because class C IP addresses 1st octet ranges from 192-223.**
2- **Since the number of usable subnets =2**

   Then $2= 2^n-2$

   So n=2 , where n is the number of bits to be borrowed from the original host field to the subnet field.

3- **Since the network is class C, and two bits are borrowed to the subnet field, so we have 6 bits remains at the new host field, thus**

   The actual number of hosts per subnet = $2^6 = 64$

4- **Since the first and last host addresses per subnet are used for network address and broad cast address respectively. Then**

   The usable number of hosts per subnet = $2^6-2= 62$

5- **We have a class C network with two host bits borrowed from the fourth octet to the the subnet field, so the binary subnet mask can be formed by putting 1's in the network and subnet fields and 0's in the host field as follows**

1st octet	2nd octet	3rd octet	4th octet	
N	N	N	S	H
11111111	11111111	11111111	11	000000

And the decimal subnet mask will be 255.255.255.192

6-

Subnet No.	Subnet bits binary value	Host bits binary values	Subnet / Host Decimal range	Usable Hosts IP addresses	Useable subnet
Subnet #0	00	000000 - 111111	0 – 63	200.10.57.1-200.10.57.62	NO
Subnet #1	01	000000 - 111111	64 - 127	200.10.57.65-200.10.57.126	YES
Subnet #2	10	000000 - 111111	128 – 191	200.10.57.129-200.10.57.190	YES
Subnet #3	11	000000 - 111111	192 - 255	200.10.57.193-200.10.57.254	NO

From the table above :The IP address of the router NIC at subnet X is 200.10.57.65

The IP address of the router NIC at subnet Y is 200.10.57.129

7-from the table

X1 decimal IP address (Source address) is 200.10.57.66

Y1 decimal IP address is (Destination address) is 200.10.57.130

a-X1 ANDing its IP address to the subnet mask

X1 binary IP address: 11001000 . 00001010 . 00111001 . 01000010

Binary subnet mask : 11111111 . 11111111 . 11111111 . 11000000

Binary anding result : 11001000 . 00001010 . 00111001 . 01000000

Decimal ANDing result is: 200.10.57.64

So the subnet to which X1 belongs is 200.10.57.64

b- X1 ANDing Destination (Y1) IP Address to the subnet mask

Y1 binary IP address: 11001000 . 00001010 . 00111001 . 10000010

Binary subnet mask : 11111111 . 11111111 . 11111111 . 11000000

Binary anding result : **11001000 . 00001010 . 00111001 . 10000000**

Decimal ANDing result is: **200.10.57.128**

So the subnet to which Y1 belongs is 200.10.57.128

c- from the results of ANDing processes in steps a and b the Host X1 finds that the destination host Y1 lies on another subnet so it forwards the packet to router NIC at the subnet X side. The router then forwards the packet to the router NIC at subnet Y which forwards it to host Y1. (if the result from steps a and b is the same, meaning that source and destination hosts on the same subnet, then the source host directs the packet directly to the destination host)

8-

a- Actual number of hosts in class C network without subnetting is 256

b- Number of IP addresses lost by unusable subnets in this example is

(2* actual number of hosts/ subnet) = 2*64 = 128

c- number of IP addresses lost in each usable subnet is

(2* number of usable subnets) = 2*2 =4

d- percentage loss of IP addresses = [(c+b) /a]* 100%= (132/256)*100% = 52%

Example2:

Your institute is given a network address 150.193.0.0 . This address must be subdivided to get at least 200 host per subnet. Answer the followings.

1. **what is the network class.**
2. **How many bits needed to be borrowed to the subnet filed.**
3. **What is the subnet mask**
4. **What is the IP address of the first host in the fifth usable subnet.**
5. **What is the number of IP addresses lost by subnetting.**

Answers:-

1. **Since the first octet in the network address is 150, then the IP address is class B because class B IP addresses 1st octet ranges from 128-191.**

2. Since the number of hosts =200

Then 200 ≤ 2^m-2

So m=8 ,

And since the total number of bits in the original host filed is 16, then the remaining bits to be borrowed to the subnet field is 8.

3- We have a class B network with eight host bits borrowed from the 3rd octet to the the subnet field, so the binary subnet mask can be formed by putting 1's in the network and subnet fields and 0's in the host field as follows

1st octet	2nd octet	3rd octet	4th octet
N	N	S	H
11111111	11111111	11111111	00000000

And the decimal subnet mask will be 255.255.255.0

4-

Subnet No.	Subnet bits (binary value)	Host bits (binary values)	Usable range of Hosts IP addresses	Useable subnet
Subnet #0	00000000	00000000 - 11111111	150.193.0.1-150.193.0.254	NO
Subnet #1	00000001	00000000 - 11111111	150.193.1.1-150.193.1.254	YES
Subnet #2	00000010	00000000 - 11111111	150.193.2.1-150.193.2.254	YES
⋮	⋮	⋮	⋮	⋮
Subnet #5	00000101	00000000 - 11111111	150.193.5.1-150.193.5.254	YES
⋮	⋮	⋮	⋮	⋮
Subnet #254	11111110	00000000 - 11111111	150.193.254.1-150.193.254.254	YES
Subnet #255	11111111	00000000 - 11111111	150.193.255.1-150.193.255.254	NO

So, the first usable host IP address in the 5th subnet 150.193.5.1

5-

a- Number of IP addresses lost by unusable subnets in this example is

(2* actual number of hosts/ subnet) = 2*256 = 512

b- number of IP addresses lost in each usable subnet is

(2* number of usable subnets) = 2*254 =508

c- IP addresses lost by subnetting = 512+508= 1020